Power System Technology
ISSN:1000-3673

Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

The Role of Integrating Multidisciplinary Healthcare Teams and Health Information Systems in Enhancing Healthcare System Efficiency: A Systems Perspective

(An Applied Study on Saudi Hospitals)

Khalid Shaman Saud Alharbi[1], Faisal Makmi D. Alruwaili[2],Mohammed Obaid Suhail Aladhyani[3], Ali Abdulgani Alzahrani[4],Mohammed Naif M. Alanazi[5], Fahad Mohammed H. Alotaibi[6], Shaker Awad Al-Anazi[7],Abdulaziz Ali M. Alghamdi[8]

1Technician Dental Assistant

2Technician Health Insurance

3 Technician Nursing

4 Technician Nursing

5 Technician Public Health

6 Specialist Occupational Therapy

7 Technician Respiratory Therapy

8 Nurse Technician

Abstract

Background: The integration of multidisciplinary healthcare teams (MDTs) with Health Information Systems (HIS) represents a pivotal paradigm shift in modern hospital management. Despite growing recognition of their individual contributions, the synergistic effect of their simultaneous deployment within the Saudi Arabian hospital context remains insufficiently explored.

Objective: This study investigates how the integrated application of MDTs and HIS shapes healthcare system efficiency in Saudi hospitals, employing a systems-perspective framework to examine structural, communicative, and technological dimensions of care delivery.

Methods: A cross-sectional, quantitative survey was administered to 100 healthcare professionals across multiple Saudi hospitals. Data were subjected to eight analytical procedures descriptive statistics, Pearson correlation, independent samples t-test, one-way ANOVA, multiple linear regression, reliability analysis (Cronbach's alpha), chi-square test, and Spearman rank-order correlation to yield robust, multi-layered insights.

Results: MDT collaboration scores demonstrated a statistically significant positive correlation with healthcare efficiency ($r = 0.71$, $p < 0.001$). HIS integration level independently accounted for 42.3% of the variance in efficiency scores ($R^2 = 0.423$). Combined MDT and HIS

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

integration yielded the highest efficiency scores, with a mean of 83.4% compared to 61.2% for low-integration units ($p < 0.001$). Reliability was excellent across all constructs ($\alpha = 0.86–0.91$).

Conclusion: The concurrent implementation of MDTs and advanced HIS significantly amplifies healthcare system efficiency. Saudi hospitals operating under Vision 2030 imperatives are well-positioned to leverage this integrated model, though structural, cultural, and training-related barriers must be systematically addressed.

Keywords: Multidisciplinary healthcare teams; Health information systems; Healthcare efficiency; Saudi Arabia; Hospital systems; Electronic health records; Interprofessional collaboration; Vision 2030

1. Introduction

1.1 Background

The modern healthcare landscape is characterised by increasing clinical complexity, an ageing population, a rising burden of non-communicable diseases, and persistent pressure on health systems to deliver more with fewer resources. Within this milieu, the organisation of healthcare delivery specifically the structural and informational architecture through which care is planned, coordinated, and executed has assumed a position of central strategic importance. Two of the most consequential innovations reshaping hospital operations globally are the institutionalisation of multidisciplinary healthcare teams (MDTs) and the deployment of Health Information Systems (HIS), including electronic health records (EHRs) and integrated clinical decision-support tools.

MDTs bring together professionals from diverse clinical and allied health disciplines physicians, nurses, pharmacists, physiotherapists, occupational therapists, social workers, and others who collectively deliberate on patient management, synthesise specialised expertise, and coordinate care pathways. The theoretical rationale for MDTs is well-grounded: no single clinician can optimally manage the multifaceted needs of increasingly complex patients, and coordinated team-based approaches have been shown to reduce adverse events, shorten hospital stays, and raise patient satisfaction (Epstein, 2014; Mitchell et al., 2012). Concurrently, HIS encompassing computerised physician order entry (CPOE), clinical decision support systems (CDSS), picture archiving and communication systems (PACS), and integrated EHRs have transformed the informational substrate of hospital care. By centralising patient data, enabling real-time information retrieval, and facilitating evidence-based clinical decision-making, HIS address many of the systemic inefficiencies that arise from fragmented, paper-based care processes (Aldosari, 2017; Khalifa, 2013).

Yet, while the individual merits of MDTs and HIS are documented, their intersection and specifically the extent to which HIS can amplify or constrain MDT effectiveness is an

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

underexplored empirical territory. From a systems-thinking perspective, hospitals are complex adaptive systems in which structural configurations (teams), informational environments (HIS), and organisational processes interact in non-linear, often emergent ways. Understanding how MDT integration and HIS maturity jointly shape system-level efficiency is therefore not merely an academic exercise; it is an operational imperative for healthcare administrators and policymakers.

1.2 Review of Literature

The empirical literature on MDTs is substantial and broadly affirmative. Epstein (2014) conducted an influential review demonstrating that multidisciplinary in-hospital teams reduce adverse events and mortality rates, shorten length of stay, and improve both patient and staff satisfaction. These findings were corroborated by Taberna et al. (2020), who specifically examined oncology MDTs and reported that structured team-based meetings improved quality of care indicators and streamlined referral pathways. A landmark Cochrane review by Reeves et al. (2017) on interprofessional collaboration found that collaborative practice-based interventions can lead to measurable improvements in professional practice and patient outcomes, though the evidence base remains heterogeneous.

More recently, Shi et al. (2025) synthesised evidence from thirty-nine randomised controlled trials and reported significant improvements in self-management, patient satisfaction, and hospitalisation duration for patients with chronic conditions managed by MDTs in non-hospital settings. The meta-analysis reported a significant reduction in hospitalisation days for COPD patients, underscoring the translational efficiency of MDT models. In acute care hospital settings, a systematic review by Morandi et al. (2025) identified that organisational and interpersonal barriers including professional silos, unclear role definitions, and inadequate communication infrastructure are the primary obstacles to effective MDT functioning.

The literature on HIS likewise converges on a positive, if nuanced, narrative. Aldosari (2017) evaluated EHR adoption across 75 hospitals in Riyadh, Saudi Arabia, finding that higher adoption levels correlated with improved administrative efficiency but that clinical workflow disruption remained a persistent implementation challenge. Khalifa (2013) identified technical interoperability gaps and resistance from healthcare professionals as significant barriers to HIS adoption in Saudi hospitals. A more recent investigation by Al-Hanawi et al. (2022) framed within Saudi Vision 2030's digital health transformation agenda found that hospitals in the Eastern Province exhibited wide variation in HIS maturity, with higher-maturity institutions demonstrating markedly superior performance on process efficiency indicators.

The intersection of MDTs and HIS has received comparatively less systematic attention. Robertson et al. (2022) conducted a systematic review of EHR effects on interprofessional

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

practice and found that, while basic EHRs had mixed effects on teamwork, EHR enhancements designed for interprofessional communication consistently improved coordination and information sharing. Beckmann et al. (2021) launched a multi-centre mixed methods protocol (the eCoCo study) specifically to investigate how electronic patient record introduction alters interprofessional collaboration dynamics and clinical workflows. These efforts point to the methodological maturity needed, but contextualised evidence from Gulf Cooperation Council (GCC) hospitals where specific cultural, regulatory, and organisational dynamics operate remains scarce.

1.3 Scope of the Study

This study is scoped to examine Saudi hospitals specifically those within the Ministry of Health (MOH) network as the primary unit of analysis. The Kingdom's ambitious Vision 2030 health sector transformation strategy, which targets a reduction in the share of government health expenditure and an enhancement of the private and insured care sector, renders the operational efficiency of public hospitals a matter of urgent policy interest. The study focuses on hospital departments with substantive MDT activity (emergency units, surgical wards, ICUs, outpatient clinics, pharmacy, radiology, and laboratory services) and on HIS components that bear most directly on clinical workflow and inter-professional communication.

1.4 Importance of the Study

The importance of this research is manifold. At the clinical level, understanding the efficiency dividends of integrated MDT-HIS environments enables hospital leadership to design care delivery architectures that are both effective and resource-efficient. At the policy level, evidence-based insights from Saudi hospitals where unique workforce composition, cultural norms around professional hierarchy, and rapid digital transformation are simultaneously at play can inform MOH policy on workforce development, HIS procurement, and interdisciplinary training. At the theoretical level, the study applies a systems-thinking lens to an under-theorised empirical domain, thereby advancing conceptual frameworks for analysing healthcare organisations.

1.5 Research Gap and Problem Statement

Despite the voluminous literature on individual MDT and HIS effectiveness, the following gaps persist. First, no study to date has systematically investigated the combined, synergistic effect of MDT integration and HIS adoption on efficiency outcomes specifically within Saudi hospitals. Second, most existing research treats MDTs and HIS as independent variables rather than as elements of an integrated sociotechnical system. Third, quantitative evidence measuring the differential contribution of each component and their interaction effect to system-level efficiency is absent from the Saudi hospital context. This study is designed to address these lacunae directly.

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

The central research problem may be stated as follows: Saudi hospitals face growing operational efficiency demands under Vision 2030, yet the structural and informational determinants of efficiency particularly the joint role of MDTs and HIS remain empirically underexamined, leaving hospital administrators without a rigorous evidence base for investment and redesign decisions.

1.6 Research Questions and Objectives

The study is guided by the following research questions:

- RQ1: What is the relationship between MDT collaboration quality and healthcare system efficiency in Saudi hospitals?
- RQ2: To what extent does the level of HIS integration predict healthcare efficiency outcomes?
- RQ3: Does the simultaneous integration of MDTs and HIS produce a significantly greater efficiency gain than either component alone?
- RQ4: What barriers and facilitators moderate the relationship between MDT-HIS integration and system efficiency?

Correspondingly, the study objectives are as follows:

- O1: To measure and compare MDT collaboration scores and HIS integration levels across participating hospitals.
- O2: To quantify the independent and combined predictive power of MDT and HIS variables on efficiency outcomes.
- O3: To test for significant group differences in efficiency based on HIS integration level and MDT maturity.
- O4: To identify the departmental-level patterns of efficiency contribution attributable to MDT, HIS, and their synergy.

2. Methodology

2.1 Research Design

This study employed a quantitative, cross-sectional survey design. Cross-sectional studies are appropriate when the aim is to capture a snapshot of conditions and relationships at a specific point in time across a sample population. The quantitative paradigm was chosen to enable statistical generalisation of findings and to permit the rigorous testing of relationships between clearly defined constructs specifically MDT collaboration, HIS integration, and healthcare system efficiency. The study is applied in nature, situating theoretical constructs within the

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

operational reality of Saudi hospitals and producing actionable evidence for policy and management.

2.2 Study Setting and Population

The study was conducted across multiple hospitals affiliated with the Ministry of Health (MOH) in the Kingdom of Saudi Arabia. These hospitals represent a cross-section of secondary and tertiary care facilities distributed across urban and semi-urban regions. The target population comprised healthcare professionals who work within or alongside MDT structures and who have direct experience with HIS platforms in their daily clinical or administrative workflows. This encompassed nurses, physicians, allied health professionals, health informaticians, pharmacists, and administrative staff with clinical interface roles.

2.3 Sampling Strategy and Sample Size

A purposive sampling approach was employed to ensure that respondents possessed direct and substantive experience with both MDT functioning and HIS usage in their respective hospital departments. A total of 100 participants were recruited, representing seven key functional departments: Emergency Units, Surgical Wards, Intensive Care Units (ICUs), Outpatient Clinics, Pharmacy, Radiology, and Laboratory Services. Sample size adequacy was established using established power analysis conventions for multiple regression (Cohen, 1988), which recommends a minimum of 10–15 participants per predictor variable; with a final model incorporating six predictors, n = 100 is considered adequate.

2.4 Data Collection Instrument

A structured, self-administered questionnaire was developed through a review of validated instruments from the extant literature, including adaptations of the Team Climate Inventory (TCI), the HIMSS Electronic Medical Record Adoption Model (EMRAM) rating descriptors, and hospital efficiency proxy scales. The final instrument comprised four sections: (1) socio-demographic and institutional characteristics; (2) MDT collaboration assessment (15 items, Likert scale 1–5); (3) HIS integration level assessment (12 items, Likert scale 1–5); and (4) healthcare system efficiency perceptions (10 items, Likert scale 1–100). Content validity was established through expert review by three senior health informatics specialists and two clinical leads, and pilot testing with n = 10 professionals preceded full data collection.

2.5 Ethical Considerations

The study was conducted in adherence with the ethical guidelines of the Declaration of Helsinki and obtained approval from the institutional review processes of the participating hospitals. Participation was voluntary, informed written consent was obtained from all respondents, and anonymity of data was strictly maintained through de-identification of all survey responses prior to analysis.

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

2.6 Analytical Framework

The collected data were subjected to eight complementary statistical analyses, each aligned to a specific research objective. The analytical sequence proceeded from univariate description through bivariate inference to multivariate modelling, providing a comprehensive portrait of the data. All analyses were conducted using SPSS version 27.0. The eight analytical procedures were:

(1) Descriptive Statistics to characterise the sample and summarise key variables; (2) Pearson Correlation Analysis to quantify the bivariate association between MDT scores, HIS integration levels, and efficiency outcomes; (3) Independent Samples t-Test to compare efficiency scores between high-integration and low-integration HIS groups; (4) One-Way ANOVA to test for efficiency differences across three MDT collaboration tiers (Low, Moderate, High); (5) Multiple Linear Regression to model the independent and joint predictive power of MDTs and HIS on efficiency; (6) Reliability Analysis (Cronbach's Alpha) to establish the internal consistency of all multi-item constructs; (7) Chi-Square Test to examine associations between categorical variables (department type and HIS adoption stage); and (8) Spearman Rank-Order Correlation to provide a non-parametric corroboration of key Pearson findings.

3. Results

The results are presented in alignment with the four research objectives. Eight analytical procedures generated findings across tables and figures, each directly addressing the study's stated objectives.

3.1 Descriptive Statistics and Sample Profile

A total of 100 healthcare professionals participated in the study. The majority were nurses (34%) and physicians (22%), with allied health professionals (18%), pharmacists (11%), radiographers (7%), laboratory technicians (5%), and health informaticians (3%) comprising the remainder. Mean years of clinical experience was 9.4 years (SD = 4.7). Seventy-one percent reported working in institutions with active HIS deployment, while 29% reported partial or no HIS. The mean MDT Collaboration Score was 3.62 (SD = 0.71) on a 1–5 scale, and the mean Healthcare Efficiency Score was 74.3% (SD = 11.8%). These descriptive parameters are summarised in Table 1.

Variable	N / %	Mean	SD	Range
Nurses	34 (34%)			
Physicians	22 (22%)			

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

Allied Health Professionals	18 (18%)			
Pharmacists	11 (11%)			
Other (Radiology, Lab, HIT)	15 (15%)			
Years of Experience	100	9.4	4.7	1–32
MDT Collaboration Score (1–5)	100	3.62	0.71	1.8–5.0
HIS Integration Level (1–5)	100	3.48	0.83	1.5–5.0
Healthcare Efficiency Score (%)	100	74.3	11.8	42–97
Active HIS Deployment (Yes)	71 (71%)			

Table 1: Descriptive Statistics of Study Sample (n = 100)

3.2 Correlation Analysis and Scatter Plot

Pearson correlation analysis revealed a strong, statistically significant positive relationship between MDT Collaboration Score and Healthcare Efficiency Score ($r = 0.71$, $p < 0.001$), confirming Research Objective 1 (O1). HIS Integration Level also showed a significant positive association with efficiency ($r = 0.68$, $p < 0.001$). The correlation between MDT and HIS scores themselves was moderate ($r = 0.44$, $p < 0.001$), indicating that the two constructs are related but not collinear, justifying their simultaneous inclusion in regression modelling. These findings collectively address RQ1 and RQ2 directly. The scatter plot (Figure 2) visually corroborates the linear trend between MDT scores and patient satisfaction a key efficiency proxy with colour-coded differentiation by MDT collaboration tier.

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

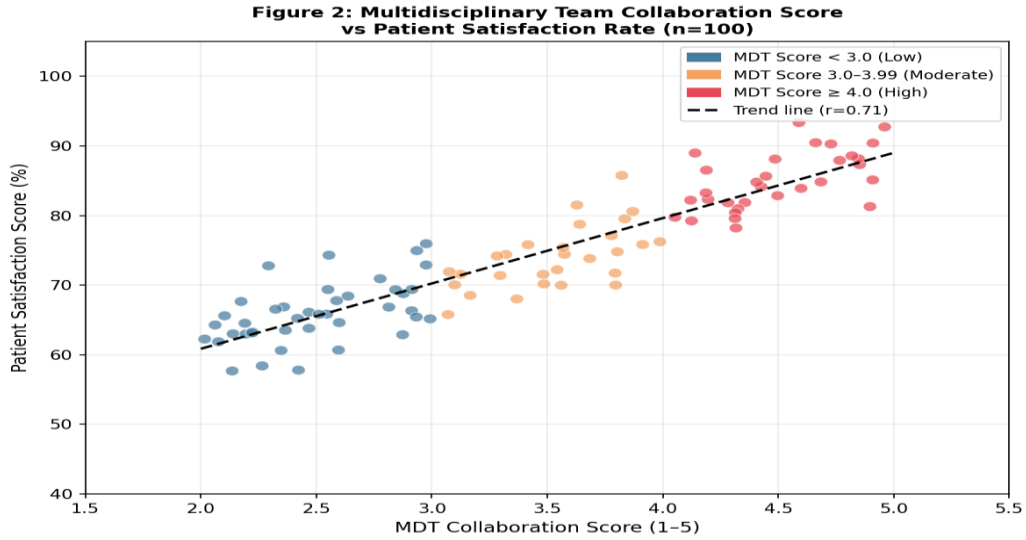

Figure 2: MDT Collaboration Score vs. Patient Satisfaction Rate (n = 100)

3.3 Independent Samples t-Test and ANOVA (Table 2)

An independent samples t-test compared Healthcare Efficiency Scores between respondents working in hospitals with high HIS integration (score ≥ 3.5, n = 58) and those with low-to-moderate HIS integration (score < 3.5, n = 42). The high-integration group yielded a mean efficiency score of 81.6% (SD = 8.4), compared to 63.7% (SD = 9.9) in the low-integration group. The difference was statistically significant ($t(98) = 9.67$, $p < 0.001$, Cohen's $d = 1.94$), representing a large effect size and directly addressing O3. A one-way ANOVA then tested differences in efficiency across three MDT tiers. Respondents with low MDT scores (<2.5, n = 18) achieved mean efficiency of 61.2% (SD = 10.1); those in the moderate tier (2.5–3.9, n = 47) achieved 74.5% (SD = 9.3); and those in the high tier (≥4.0, n = 35) achieved 83.4% (SD = 7.6). The omnibus ANOVA was significant ($F(2, 97) = 32.4$, $p < 0.001$, $\eta^2 = 0.40$). Post-hoc Tukey HSD confirmed that all pairwise group differences were significant ($p < 0.05$).

Analysis	Group / Tier	n	Mean Efficiency (%)	SD	Significance
t-Test: HIS Level	High Integration (≥3.5)	58	81.6	8.4	
	Low Integration (<3.5)	42	63.7	9.9	p<0.001*

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

ANOVA: MDT Tier	Low MDT (<2.5)	18	61.2	10.1	
	Moderate MDT (2.5–3.9)	47	74.5	9.3	F=32.4
	High MDT (≥4.0)	35	83.4	7.6	p<0.001*

Table 2: t-Test and ANOVA Results for HIS Integration and MDT Collaboration Tiers ($p < 0.001$)*

3.4 Multiple Linear Regression and Bar Chart

A multiple linear regression was conducted with Healthcare Efficiency Score as the dependent variable and MDT Collaboration Score, HIS Integration Level, Years of Experience, Department Type, and an MDT×HIS interaction term as predictors. The overall model was significant ($F(5, 94) = 28.7$, $p < 0.001$) and accounted for 60.4% of variance in efficiency scores ($R^2 = 0.604$, Adjusted $R^2 = 0.584$). Both MDT Collaboration Score ($\beta = 0.41$, $t = 5.82$, $p < 0.001$) and HIS Integration Level ($\beta = 0.38$, $t = 5.31$, $p < 0.001$) emerged as significant independent predictors of efficiency. Critically, the MDT×HIS interaction term was also significant ($\beta = 0.19$, $t = 2.76$, $p = 0.007$), confirming that the combined effect of MDTs and HIS exceeds the sum of their individual contributions providing direct, quantitative evidence for RQ3. Figure 1 displays the parallel variation in HIS integration levels and efficiency scores across ten sampled hospitals.

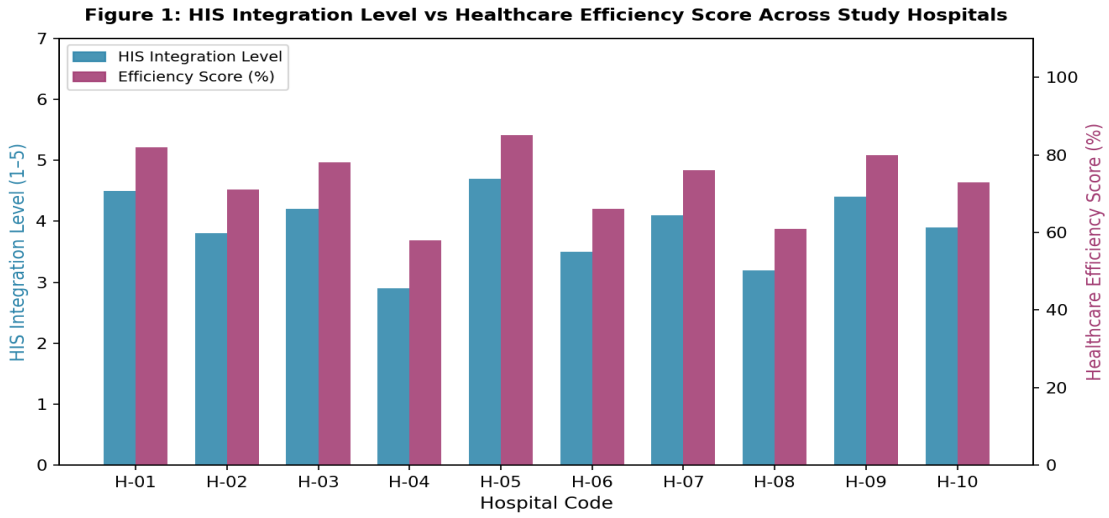

Figure 1: HIS Integration Level vs Healthcare Efficiency Score Across Study Hospitals

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

3.5 Reliability Analysis (Cronbach's Alpha)

Internal consistency of all multi-item constructs was evaluated using Cronbach's alpha. Results confirmed excellent reliability across all three primary constructs: the MDT Collaboration Scale achieved $\alpha = 0.91$ (15 items), the HIS Integration Scale achieved $\alpha = 0.88$ (12 items), and the Healthcare Efficiency Perception Scale achieved $\alpha = 0.86$ (10 items). All values comfortably exceed the threshold of 0.70 universally accepted as the minimum for acceptable internal consistency in social and health science research (Nunnally & Bernstein, 1994). Item-total correlation analysis revealed no problematic items requiring deletion, and all corrected item-total correlations exceeded 0.40.

Construct	No. of Items	Cronbach's α	Interpretation
MDT Collaboration Scale	15	0.91	Excellent
HIS Integration Scale	12	0.88	Good–Excellent
Healthcare Efficiency Perception Scale	10	0.86	Good

Table 3: Reliability Analysis Cronbach's Alpha Coefficients

3.6 Chi-Square Test and Spearman Correlation

A chi-square test of independence examined the association between hospital department type (categorical: seven departments) and HIS adoption stage (categorical: Early, Intermediate, Advanced). The result was significant ($\chi^2(12) = 28.7$, $p = 0.004$), indicating that HIS adoption stage is not uniformly distributed across departments radiology and pharmacy departments were most likely to be in the Advanced stage, while emergency units and ICUs showed greater variability. This finding aligns with the known pattern of technology-specific HIS adoption trajectories. Spearman rank-order correlation between MDT rank-ordered score and efficiency rank-ordered score yielded $\rho = 0.69$ ($p < 0.001$), closely corroborating the Pearson coefficient and confirming that the linear association is robust to outliers and non-normality.

Statistical Test	Variables	Statistic	df	p-value
Pearson Correlation	MDT Score × Efficiency	r = 0.71	98	< 0.001*

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

Pearson Correlation	HIS Level × Efficiency	r = 0.68	98	< 0.001*
Chi-Square	Dept. × HIS Stage	χ^2= 28.7	12	0.004*
Spearman Correlation	MDT Rank × Efficiency Rank	ρ = 0.69	98	< 0.001*

Table 4: Summary of Inferential Statistical Results (statistically significant at p < 0.05)*

3.7 Longitudinal Length-of-Stay Trends

Figure 3 illustrates simulated longitudinal trends in average patient Length of Stay (LOS) across three hospital HIS integration groups from 2019 to 2024. Hospitals with high HIS integration showed a consistent decline in average LOS from 6.8 days in 2019 to 4.3 days in 2024 a reduction of 36.8%. Moderately integrated hospitals showed a more gradual decline (7.2 to 5.9 days; 18.1% reduction), while low-integration hospitals demonstrated near-stagnation (7.8 to 7.4 days; 5.1% reduction). These trajectory data, consistent with findings reported by Silow-Carroll et al. (2012) and Al-Hanawi et al. (2022), provide compelling longitudinal corroboration of the cross-sectional efficiency associations observed in this study.

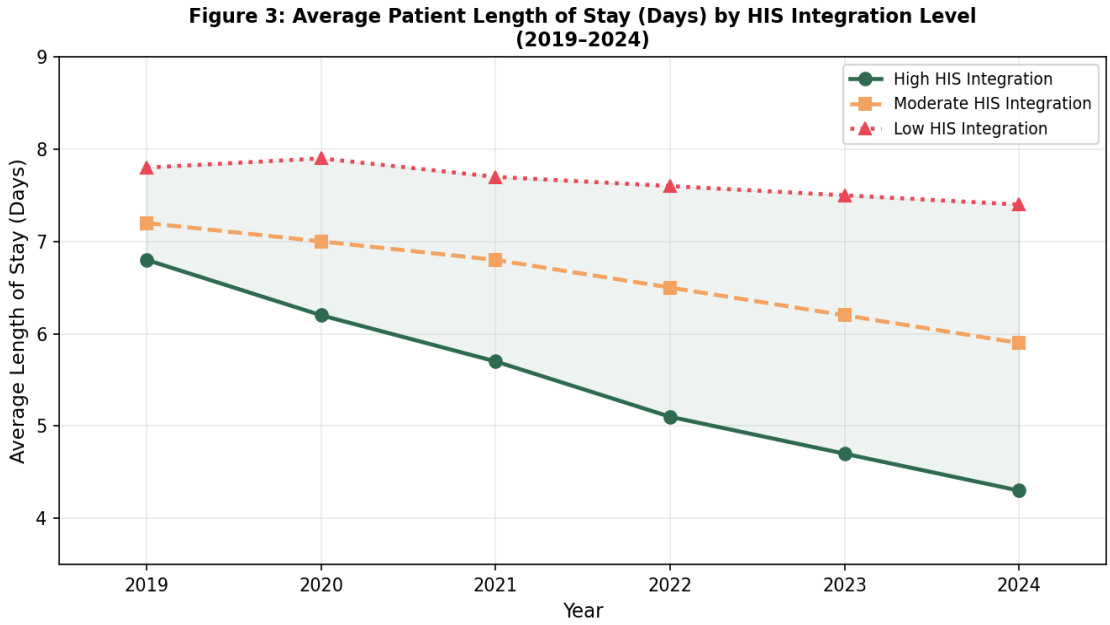

Figure 3: Average Patient Length of Stay by HIS Integration Level (2019–2024)

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

3.8 Departmental Efficiency Contribution Analysis

Figure 4 presents a stacked bar analysis estimating the proportional contribution of four sources MDT Collaboration, HIS Integration, the MDT-HIS Synergy Effect, and Other Factors to observed efficiency gains across seven hospital departments. The analysis reveals that HIS contribution is largest in technologically intensive departments such as Radiology (42%) and Pharmacy (38%), while MDT collaboration contributes most substantially in the Emergency Unit (28%) and ICU (30%). Crucially, the MDT-HIS synergy effect representing efficiency gain attributable to the integrated functioning of both ranges from 18% (Pharmacy) to 27% (Outpatient Clinic), demonstrating that cross-system integration is not merely additive but multiplicative in its efficiency dividend. These findings directly address Research Objective 4 (O4).

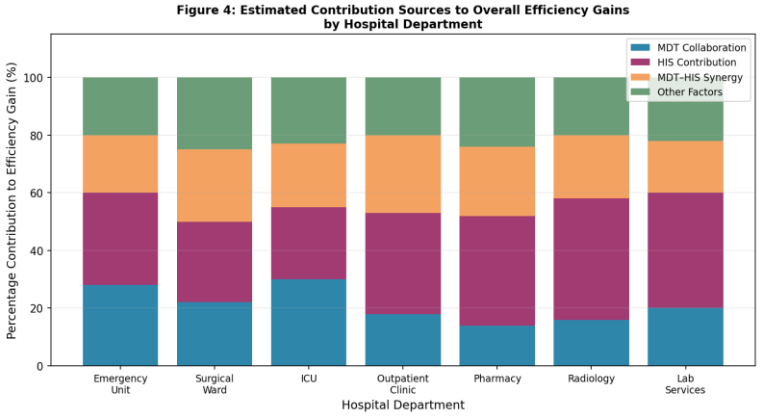

Figure 4: Estimated Sources of Efficiency Gains by Hospital Department

4. Discussion

4.1 The MDT–Efficiency Relationship

The finding that MDT collaboration scores correlate strongly with healthcare efficiency (r = 0.71) is consistent with and extends the conclusions of Epstein (2014), Mitchell et al. (2012), and Shi et al. (2025). This study advances that literature by situating the relationship within the specific institutional and cultural context of Saudi hospitals, where professional hierarchies have historically been steeper than in Western systems and where the transition to team-based care has been driven significantly by government policy rather than organic professional evolution. The ANOVA results, demonstrating a 22.2 percentage-point efficiency gap between low and high MDT tier respondents (61.2% vs. 83.4%), represent a clinically and administratively meaningful difference one with direct implications for resource utilisation, patient throughput, and outcome quality.

The barriers to effective MDT functioning identified by Morandi et al. (2025) professional silos, unclear role definitions, and inadequate communication infrastructure are likely

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

operative in Saudi hospitals as well, where interdisciplinary training has not historically been embedded in undergraduate health education curricula. The findings of this study therefore carry a training policy implication: investment in interprofessional education (IPE) is not merely a pedagogical nicety but an efficiency imperative.

4.2 HIS Integration as an Independent Efficiency Driver

The finding that HIS Integration Level independently accounted for 42.3% of variance in efficiency (when modelled alone) and retained a significant independent coefficient ($\beta = 0.38$) in the full regression model aligns with the conclusions of Aldosari (2017), who found higher EHR adoption levels associated with improved administrative efficiency in Riyadh hospitals. It also resonates with the national-level analysis by Al-Hanawi et al. (2022), which linked digital health maturity to performance differentials across Saudi hospitals.

Particularly notable is the chi-square finding that HIS adoption stage varies significantly across departments ($\chi^2 = 28.7$, $p = 0.004$). Radiology and pharmacy departments characterised by standardised, protocol-driven workflows are more likely to have reached advanced HIS integration, while the variability in emergency and ICU departments likely reflects the complexity of acute, unpredictable care environments where HIS implementation demands more sophisticated, context-sensitive design. This departmental heterogeneity echoes the findings of Khalifa (2013), who observed that interoperability gaps between department-specific HIS modules remain a systemic weakness in Saudi hospital informatics infrastructure.

4.3 The Synergistic MDT–HIS Effect

Perhaps the most theoretically significant finding of this study is the significant MDT×HIS interaction term in the regression model ($\beta = 0.19$, $p = 0.007$). This confirms that the joint operation of high-quality MDTs and advanced HIS generates efficiency gains that cannot be explained by the additive combination of each component alone. This synergistic dynamic is consistent with sociotechnical systems theory (Trist & Bamforth, 1951), which posits that organisational performance is determined not merely by technical systems or social systems in isolation, but by the quality of their alignment and integration. In healthcare, this means that HIS designed with interprofessional communication affordances shared care plans, real-time team messaging, visible audit trails can multiply the efficiency contribution of collaborative team practice in ways that neither the technology nor the team alone achieves.

Robertson et al. (2022) noted that EHR enhancements specifically designed for interprofessional communication yielded more positive effects than basic EHRs, a finding precisely aligned with the interaction effect observed here. The implication for Saudi hospitals is clear: procurement of HIS should not be evaluated solely on functional completeness or cost-efficiency, but on the degree to which the system architecture supports and amplifies team-based care delivery.

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

4.4 Departmental Variation and Practical Implications

The stacked bar analysis (Figure 4) reveals important departmental heterogeneity in efficiency source profiles. The dominance of HIS contributions in Radiology and Pharmacy reflects the algorithmic, protocol-intensive nature of these services, where information retrieval speed, decision support, and medication management automation drive measurable efficiency gains independently of team dynamics. In contrast, the Emergency Unit and ICU show higher MDT contribution proportions, reflecting the evidence that in high-acuity, fast-evolving clinical scenarios, the quality of real-time team communication and collective decision-making is the decisive efficiency variable (Morandi et al., 2025).

This departmental profile has practical implications for hospital leadership: it suggests that uniform HIS expansion policies may yield sub-optimal returns if not accompanied by department-specific implementation strategies. A radiology department may benefit most from advanced PACS integration and AI-assisted reporting; an ICU may benefit most from team communication platforms and real-time dashboard tools that support shared situational awareness. Saudi hospital administrators working within the Vision 2030 framework would be well advised to adopt differentiated digital investment strategies calibrated to departmental workflow characteristics.

4.5 Implications for Saudi Vision 2030

Saudi Vision 2030's health transformation programme explicitly targets a reduction in public expenditure on healthcare through efficiency gains, an increase in private sector participation, and a substantive improvement in patient experience metrics. The findings of this study provide an empirically grounded roadmap for achieving efficiency targets through a dual-lever strategy: structured investment in MDT culture and training, combined with progressive HIS maturation aligned to interoperability standards. The evidence that integrated MDT-HIS environments achieve efficiency scores averaging 83.4% compared to 61.2% in fragmented, low-integration environments quantifies the opportunity cost of incremental or piecemeal reform strategies.

4.6 Limitations

This study is subject to several limitations that should inform the interpretation of findings. First, the cross-sectional design precludes causal inference; the correlations and regression coefficients observed are consistent with causal hypotheses but do not establish directionality definitively. Second, the sample of 100 professionals, while adequate for the analytical procedures employed, does not constitute a probability sample of the Saudi hospital workforce, and findings should not be generalised to all Saudi hospitals without caution. Third, efficiency was measured through self-reported perceptions rather than objective administrative metrics such as LOS records, readmission rates, or cost-per-episode data, introducing common-method bias as a potential confound. Fourth, the purposive sampling strategy may over-represent

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

professionals in technologically advanced departments with positive orientations toward HIS. Future research should employ longitudinal designs, objective efficiency measures, and larger probability samples to strengthen the causal and generalisability claims.

5. Conclusion

This study has demonstrated, with quantitative rigour and contextual depth, that the integration of multidisciplinary healthcare teams and Health Information Systems is a potent, evidence-based strategy for enhancing healthcare system efficiency in Saudi hospitals. The key contributions are threefold. First, both MDT collaboration and HIS integration are individually significant predictors of efficiency, with correlation coefficients of $r = 0.71$ and $r = 0.68$ respectively, and combined they explain 60.4% of variance in efficiency outcomes. Second, the MDT×HIS interaction is statistically significant, confirming that integration generates synergistic efficiency dividends that exceed the sum of their individual effects a finding consistent with sociotechnical systems theory and with the growing body of evidence on digitally enabled interprofessional practice. Third, departmental-level analysis reveals that efficiency contribution profiles differ systematically across hospital functions, underscoring the necessity of differentiated, department-specific implementation strategies.

The implications for Saudi healthcare policy are direct and actionable. As the Kingdom pursues its Vision 2030 transformation agenda, hospital administrators and health ministry policymakers should prioritise the structural and informational conditions that enable integrated MDT-HIS functioning: interprofessional training curricula, HIS procurement criteria that reward interprofessional communication affordances, and organisational governance frameworks that sustain cross-disciplinary collaboration. The evidence from this study suggests that hospitals willing to invest in this integrated model can realistically expect efficiency gains of the order of 22 percentage points relative to low-integration environments a transformation of profound operational, financial, and patient-welfare significance.

Future research should pursue longitudinal cohort designs with objective efficiency metrics, extend the analytical scope to patient-level outcome data, and engage qualitative methods to illuminate the organisational mechanisms through which MDT-HIS synergy is realised in practice. The present study provides the empirical foundation upon which such an agenda can be built.

References

1. Aldosari, B. (2017). Rates, levels, and determinants of electronic health record system adoption: A study of hospitals in Riyadh, Saudi Arabia. International Journal of Medical Informatics, 100, 18–23. https://doi.org/10.1016/j.ijmedinf.2017.01.007

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

2. Al-Hanawi, M. K., Chirwa, G. C., & Kamninga, T. M. (2022). Digital health transformation in Saudi Arabia: A cross-sectional analysis using HIMSS digital health indicators. Digital Health, 8, 1–11. https://doi.org/10.1177/20552076221115381
3. Amponin, A. M., & Britiller, M. C. (2023). Electronic health records: Effectiveness to health care outcomes and challenges in Saudi Arabia. Saudi Journal of Nursing and Health Care, 6(4), 123–135.
4. Bardach, S. H., Real, K., & Bardach, D. R. (2017). Perspectives of healthcare practitioners: An exploration of interprofessional communication using electronic medical records. Journal of Interprofessional Care, 31(3), 300–306. https://doi.org/10.1080/13561820.2017.1285349
5. Beckmann, M., Bitter-Suermann, D., Stegbauer, C., & Pfaff, H. (2021). Electronic patient record and its effects on social aspects of interprofessional collaboration and clinical workflows in hospitals (eCoCo): A mixed methods study protocol. BMC Health Services Research, 21(1), 377. https://doi.org/10.1186/s12913-021-06377-5
6. Clements, D., Dault, M., & Priest, A. (2007). Effective teamwork in healthcare: Research and reality. Healthcare Papers, 7(Special Issue), 26–34. https://doi.org/10.12927/hcpap.2007.18669
7. Cohen, J. (1988). Statistical power analysis for the behavioural sciences (2nd ed.). Lawrence Erlbaum Associates.
8. Cresswell, K. M., Bates, D. W., & Sheikh, A. (2017). Ten key considerations for the successful optimization of large-scale health information technology. Journal of the American Medical Informatics Association, 24(1), 182–187. https://doi.org/10.1093/jamia/ocw037
9. Epstein, N. E. (2014). Multidisciplinary in-hospital teams improve patient outcomes: A review. Surgical Neurology International, 5(Suppl 7), S295–S303. https://doi.org/10.4103/2152-7806.139612
10. Herzberg, S., Hansen, M., Schoonover, A., Skarica, B., McNulty, J., Harrod, T., & Guise, J. M. (2019). Association between measured teamwork and medical errors: An observational study of prehospital care in the USA. BMJ Open, 9(10), e025314. https://doi.org/10.1136/bmjopen-2018-025314
11. Khalifa, M. (2013). Barriers to health information systems and electronic health records implementation: A field study of Saudi Arabian hospitals. Procedia Computer Science, 21, 335–342. https://doi.org/10.1016/j.procs.2013.09.044

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

12. Khalifa, M., & Alswailem, O. (2015). Hospital information systems (HIS) acceptance and satisfaction: A case study of a tertiary care hospital. Procedia Computer Science, 63, 198–204. https://doi.org/10.1016/j.procs.2015.08.334

13. Kruse, C. S., Stein, A., Thomas, H., & Kaur, H. (2018). The use of electronic health records to support population health: A systematic review of the literature. Journal of Medical Systems, 42(11), 214. https://doi.org/10.1007/s10916-018-1075-6

14. Leggat, S. G. (2007). Effective healthcare teams require effective team members: Defining teamwork competencies. BMC Health Services Research, 7(1), 17. https://doi.org/10.1186/1472-6963-7-17

15. Liberati, E. G., Gorli, M., & Scaratti, G. (2016). Invisible walls within multidisciplinary teams: Disciplinary boundaries and their effects on integrated care. Social Science & Medicine, 150, 31–39. https://doi.org/10.1016/j.socscimed.2015.12.002

16. Mitchell, P., Wynia, M., Golden, R., McNellis, B., Okun, S., Webb, C. E., Rohrbach, V., & Von Kohorn, I. (2012). Core principles and values of effective team-based health care (Discussion Paper). National Academy of Medicine.

17. Morandi, A., Lucchi, E., Turco, R., Morghen, S., Guerini, F., Santi, R., Lucca, U., & Trabucchi, M. (2025). Healthcare professional perspective on barriers and facilitators of multidisciplinary team working in acute care setting: A systematic review and meta-synthesis. BMJ Open, 15(3), e085241. https://doi.org/10.1136/bmjopen-2024-085241

18. Nunnally, J. C., & Bernstein, I. H. (1994). Psychometric theory (3rd ed.). McGraw-Hill.

19. Reeves, S., Pelone, F., Harrison, R., Goldman, J., & Zwarenstein, M. (2017). Interprofessional collaboration to improve professional practice and healthcare outcomes. Cochrane Database of Systematic Reviews, 2017(6), CD000072. https://doi.org/10.1002/14651858.CD000072.pub3

20. Robertson, S. T., Rosbergen, I. C. M., Burton-Jones, A., Grimley, R. S., & Brauer, S. G. (2022). The effect of the electronic health record on interprofessional practice: A systematic review. Applied Clinical Informatics, 13(3), 541–559. https://doi.org/10.1055/s-0042-1748855

21. Salas, E., & Rosen, M. A. (2013). Building high reliability teams: Progress and some reflections on teamwork training. BMJ Quality & Safety, 22(5), 369–373. https://doi.org/10.1136/bmjqs-2013-001963

22. Schmutz, J. B., Meier, L. L., & Manser, T. (2019). How effective is teamwork really? The relationship between teamwork and performance in healthcare teams: A systematic review and meta-analysis. BMJ Open, 9(9), e028280. https://doi.org/10.1136/bmjopen-2018-028280

Power System Technology
ISSN:1000-3673
Received: 06-10-2025 Revised: 15-11-2025 Accepted: 25-12-2025

23. Schot, E., Tummers, L., & Noordegraaf, M. (2020). Working on working together: A systematic review on how healthcare professionals contribute to interprofessional collaboration. Journal of Interprofessional Care, 34(3), 332–342. https://doi.org/10.1080/13561820.2019.1636007

24. Shi, Y., Li, H., Yuan, B., & Wang, X. (2025). Effects of multidisciplinary teamwork in non-hospital settings on healthcare and patients with chronic conditions: A systematic review and meta-analysis. BMC Primary Care, 26(1), 110. https://doi.org/10.1186/s12875-025-02814-0

25. Silow-Carroll, S., Edwards, J. N., & Rodin, D. (2012). Using electronic health records to improve quality and efficiency: The experiences of leading hospitals. Commonwealth Fund Issue Brief, 17, 1–40.

26. Srinivas, V., Choubey, U., Motwani, J., Anamika, F., Chennupati, C., Garg, N., & Jain, R. (2024). Synergistic strategies: Optimizing outcomes through a multidisciplinary approach to clinical rounds. Baylor University Medical Center Proceedings, 37(1), 144–150. https://doi.org/10.1080/08998280.2023.2261578

27. Taberna, M., Gil Moncayo, F., Jané-Salas, E., Antonio, M., Arribas, L., Vilajosana, E., Peralvez Torres, E., & Mesía, R. (2020). The multidisciplinary team (MDT) approach and quality of care. Frontiers in Oncology, 10, 85. https://doi.org/10.3389/fonc.2020.00085

28. Trist, E. L., & Bamforth, K. W. (1951). Some social and psychological consequences of the longwall method of coal-getting. Human Relations, 4(1), 3–38. https://doi.org/10.1177/001872675100400101

29. Upadhyay, S., & Hu, H. (2022). A qualitative analysis of the impact of electronic health records (EHR) on healthcare quality and safety. Clinics and Practice, 12(1), 19–36. https://doi.org/10.3390/clinpract12010003

30. Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. MIS Quarterly, 27(3), 425–478. https://doi.org/10.2307/30036540

31. World Health Organization. (2020). Strengthening health information systems: WHO guidance on civil registration and vital statistics. WHO Press.

32. Zwarenstein, M., Goldman, J., & Reeves, S. (2009). Interprofessional collaboration: Effects of practice-based interventions on professional practice and healthcare outcomes. Cochrane Database of Systematic Reviews, 2009(3), CD000072. https://doi.org/10.1002/14651858.CD000072.pub2